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THE CLIMATE OF SENEGAL.*

WE may introduce to our readers the work noted below as the best on the climate of the West Coast of Africa, with which we are acquainted, and we write this with a goodly pile of similar works on our table, and among them Dr. Horton's capital *Climate and Meteorology of Western Africa*, but he does not appear to have had opportunities for such systematic observations as those now published by Dr. Borius. It must also be recollected that Dr. Horton's work was published in 1867, and that meteorology is progressing at a yearly increasing speed. Lastly, Dr. Borius, as Membre de la Société Météorologique de France, has had good training, and in his preface he expresses his acknowledgmenis for advice and assistance received from M. Ch. Sainte-Claire Deville and from M. Renou. It is not, therefore, remarkable that in W. African meteorology Dr. Borius has left all others far behind.

The French colony of Senegal, or as it is perhaps better known, Senegambia surrounds the intersection of 15° W. longitude and 15° N. latitude, and lies mainly between the rivers Senegal and Gambia. The author divides his work into five sections, namely, the climate of (1) the island of Goree, (2) St. Louis, (3) Dagana, (4) Bakel, and (5) Senegal in general. Each section is very systematically arranged; the topography of the district being given first, then its geology, then a history of the various instruments employed for meteorology, the hours of their observation, the names of the observers and a list of the records which have been preserved; then follows a careful description of the position of the instruments used, and a woodcut which renders the explanation complete.

The author in various sections proves several points connected with temperature, but it appears to us that he occupies unnecessary space in combating the notion that the temperature of Goree is liable to sudden changes. All *prima facie* evidence is in favour of equability of temperature, and when to this is added that of the ten years' observations embodied in this work, we think that Dr. Borius might have contented himself with one or two strongly-worded paragraphs, and have left those who have spread false statements to their own reflections.

* *Recherches sur le Climat du Sénégal.* Par DR. A. BORIUS. Paris: Gauthier-villars, 1875. 8vo, xiv-320 pages, 1 plate.

Goree.—The following table epitomizes some of the most important meteorological elements for the first station, Goree, an island, but almost close to the continent—

Date.	1856—65.	1856—60.			1858—65.	
	Mean Temperature	Mean Pressure 19 ft. above mean sea.	Mean Elastic Force.	Mean Humidity.	Rainfall Amount.	Days.
	°	in.	in.	0—100.	in.	
January	68·5	29·886	·585	83	·01	
February.....	66·0	·863	·549	83	·07	
March	68·0	·823	·571	81	...	1
April	68·9	·815	·622	85	·01	
May	71·6	·831	·714	86	·01	
June	78·3	·835	·891	86	·84	1
July..	81·3	·823	·955	87	4·05	6
August.....	81·5	·808	·961	87	10·92	14
September ...	82·2	·812	·988	89	4·68	9
October	82·0	·804	·999	87	·28	1
November ...	78·1	·815	·867	85	·10	1
December.....	71·6	29·863	·611	77	·01	
Mean	74·8	29·831	·776	85	20·95	33

Highest shade temperature, October 11th, 1861..... 91·4
Lowest ,, ,, January 28th, 1859..... 57·2

With respect to the rainfall, only two notes are necessary; (1) that the gauge was on a roof about 19 ft. above the ground and that therefore the true fall at Goree is rather larger than that stated above, and (2) that Dr. Borius says that the floods in the river Senegal are such as to prove that the rainfall must be much heavier in the interior. He incidentally quotes the mean rainfall (1846–50) at Cayenne, 138·32, and at Madagascar 104·18.

The tension of vapour and humidity are considered by Dr. Borius to be rather too high, but no better data exist. The amount of cloud is not recorded in the usual way, but it is evidently small, for in a typical year 1860, the sky was at 6 a.m. and 4 p.m. absolutely free from cloud on 99 and 134 occasions respectively. This cloudless sky is, however, by no means an advantage, for it allows the vertical sun to exert its full force. The author's description of the noon-day heat of Central Africa seems so calmly truthful that we translate a few paragraphs.

"In the *dry season*, the fine season, our journal only records 15 overcast days, while there are 68 with light clouds, and 100 absolutely cloudless. It is especially in March, April, and May that the sun darts his pitiless rays for 12 or 13 hours on the soil, which is scorched and destitute of all traces of vegetation. On the coast, thanks to the neighbourhood of the sea, this solar radiation is happily bearable and the heat is only painful to those who are obliged to expose themselves. But in the interior, at Bakel for instance, the effect of the sun is very great. Then is it that the dessicated earth can support no active vegetation, that in the

middle of the day even the natives cannot walk barefoot on the burning sands, but are compelled to seek refuge in their huts. Animals of all descriptions, both wild and tame, shun it equally and seek any shelter from its rays.

"When this star shines from near the zenith, silence spreads over nature; the birds cease their song and go to sleep, except a few powerful eagles which soar upwards to the cooler strata of high altitudes, where, almost lost to sight, they hover in silent solitude.

"The siesta is not a need for man alone, most animals take it in these climates, nor is it peculiar to Senegal, for it prevails throughout all tropical regions. Nothing equals the majestic silence of the immense forests of equatorial Africa, when the sun is in the zenith of its power. Even the insects appear to partake of the general repose of nature, the sound of them no longer guides the researches of entomologists, who at this time can only find them under the shelter of leaves. This general state of all living creatures is not ordinary sleep, a special word is necessary to designate it."

It is merely necessary to add a word or two calling attention to the very heavy dew which prevails during the evening and night hours, and which is so copious as to damp the clothes of those who are so unwise as to expose themselves unnecessarily to its influence.

St. Louis.—This is the capital of the French possessions on the African coast, and with its suburbs contains a population of 15,700 persons; it is built on two islands, or more properly on two sand banks, in the river Senegal, and is so little elevated above the sea that it was frequently inundated, until the floods were excluded by strongly built quays. In addition to a long series of observations made by various resident medical officers (and of which records nine-tenths appear to be lost), a set of observations were made by the author during 1873 and 1874. He was furnished with a complete set of the ordinary meteorological instruments, and placed them upon a stand of the usual French pattern. He also employed the *thermomètre fronde*, and as his remarks upon mean temperature have a more than local interest and application, we reproduce them.

MEAN TEMPERATURE.

"What is the relative value of the various methods adopted for the determination of the temperature of a country, and which shall we select as the true mean temperature of St. Louis? Let us first examine the two series of observations—those from the shade thermometer and those from the *thermomètre-fronde* used in the shade with due attention to the precautions recommended.

"The differences between the two means are between 0°·4 and 0°·9 in the dry season, and between 0°·2 and 0°·4 in the winter. The mean yearly difference is 0°·4, the *thermomètre-fronde* being always the higher, whereas, in France it is usually lower than the shade thermometer.

"Are we hence justified in assuming that the difference between the two thermometers is at Senegal always in the opposite direction to that in the temperate zone?

"If the *thermomètre-fronde* has given us results slightly too high, we think that in observing this instrument in a garden, above a turfed

surface, we should have obtained, as in France, a mean lower than that indicated on the thermometer stand.

"This impression is justified by a note which the talented director of the observatory of Saint-Maur (Paris), has had the kindness to send to us, with permission to insert it in this work. We recommend the perusal of this note to our naval colleagues, who will thereby learn to avoid useless observations, and how to make good ones both on board ship and in our colonies. The high scientific standing of M. Renou, gives special importance to his remarks.

NOTE ON THE DETERMINATION OF THE TEMPERATURE OF THE AIR.
By M. E. RENOU.

"The observation of the temperature of the air, by means of a fixed thermometer, is generally very inaccurate, at least, when one has not a suitable thermometer stand, placed over grass, in a sufficiently open space, the values obtained will differ from the true temperature of the air.

"The *thermomètre-fronde* was arranged in order to overcome this difficulty; it merely consists of a light mercurial thermometer graduated on the stem, which is swung round in the shade by a string 2 ft. long, with a speed of about eight revolutions per second."

[Radius being 2 ft., the circumference is 12½ ft., and therefore the velocity quoted above is 100 ft. per second, or, more than a mile a minute. We find it difficult to count such rapid revolutions, and cannot satisfy ourselves that eight revolutions per second can be obtained without mechanical arrangements, however, four revolutions are probably as good as eight, and four are both obtainable and countable.—ED. M. M.]

"In order to make an observation, the observer should so place himself in the shade of some small object, that the wind either meets him full in the front, or completely on one side, the object being to prevent the air which acts upon the thermometer from having been previously affected by the observer's body. It will generally be found that the value thus obtained is less than that given by the fixed thermometer. When there is much reflected light, it is not unusual to find the *thermomètre-fronde* in full sun lower than that in the shade, and which is supposed to give the true temperature of the air."

"Persons not conversant with physics may fancy that the wind lowers the temperature of the *thermomètre-fronde* below that of the air, but that is only the case when the thermometer is damp, a source of error against which it is always necessary carefully to guard. A dry thermometer thus treated *develops heat*, but only to an unappreciable extent."

"It is unnecessary to use the *thermomètre-fronde* in addition to the ordinary instrument on the stand; slight differences will be found, but they neutralise one another in the yearly means. But it is very interesting occasionally to compare the fixed instrument with simultaneous observations of the *thermomètre-fronde* made in the nearest exposed place, in the full sweep of the wind and in the shade of a single isolated object like the trunk of a tree."

"No ordinary place of observation can be considered as proved to be satisfactory until its records have been submitted to this test at all seasons and at all observation hours."

"On board ship, the *thermomètre-fronde* will alone give good results, thermometers fixed to the masts are not only exposed to reflection, but both by changes in the position of the sun in its daily course, and by the variation in the direction of the ship's head, are continually liable to exposure to the direct rays of the sun."

The author then returns to his subject, and decides that the mean temperature of St. Louis is 73°·8 or 1°·0 lower than Goree; the extremes are, however, greater, being 101°·8 and 48°·6 respectively, the maximum of 101°·8 on April 2, 1874, io undoubtedly correct, being confirmed by the shade reading at 1 p.m., of 99°·9 and *thermomètre-fronde* of 100°·6.

The rainfall of St. Louis is very small, very variable in amount, and nearly all falls in July (2·24), August (9·69), and September (2·91), August alone having upwards of 60 per cent. of the yearly total. During the following eight years no rain fell in April or December, and the yearly totals were—

1861.....	11·54 in.	1868.....	11·97 in.
1862.....	21·97	1869.....	25·55
1863.....	5·55	1870.....	16·06
1864.....	15·87	1873..	14·12

For three years simultaneous observations were made at Goree and St. Louis, with the following results—

	Goree.		St. Louis.		Goree = 100 St. Louis =
	in.		in.		
1861.....	14·69	.....	11·54	.....	78
1862..... ..	23·62	.....	21·97	.....	93
1863.....	18·31	.....	5·55	.....	30

As to the rainfall of the interior no useful records exist.

Dr. Borius made a set of observations (with Piché's evaporator) for twelve months, the total amount indicated being 78 inches.

The mean pressure of St. Louis cannot differ materially from that at Goree; the mean of 12 months' observations (6, 10, 1, 4, 9) by Dr. Borius, reduced to 32° but not corrected for instrumental error, was 29·894 at 15 ft. above sea, say 29·91 at sea level. Three years' observations, made previously at the same hours, gave 29·29, correcting the value in the table on page 18 for elevation, it gives for Goree 29·85, it therefore seems probable that the true pressure in that district is within a few hundredths of 29·90.

Before leaving the subject of pressure, we may compare the values here given, with those deducible from the isobars of Buchan and Wojeikow—

		Dr. Borius.			Buchan.	Wojeikow.
	Goree.	St. Louis.	Mean.			
	in.	in,	in.		in.	in.
January .....29·904	...	29·941	... 29·92	...	29·98	... 30·04
July..... . 29·841	...	29·917	... 29·88	...	30·08	... 29·96
Year .....29·85	...	29·92	... 29·89	...	29·96	... —

Dagana.—Very few observations have been made at this town, which is about 75 miles inland, on the bank of the Senegal, a good thermometric series, however, were taken (6 a.m., 2 p.m., 9 p.m.) by the author in 1862, which give the mean temperature as 78°·4, the maximum as 105°·8, and the minimum 55°·4.

Bakel.—The observations at this station, which is about 320 miles inland, are unfortunately very incomplete, but although Bakel is at a considerable elevation, its distance from the sea renders it extremely hot, Dr. Borius assigns for its mean annual temperature 83°·7, and for its maxima and minima, respectively, 110°·5, and 58°·3. Questions often arise as to the temperature of the soil in tropical climates—the following is in this respect interesting.

"According to a note accompanying the observations of M. Verdier in 1872, when the shade temperature was 107°·1, a thermometer carried in the sun was 113°, and placed upon the sand it went up to 142°."

Our readers will infer from the space which we have devoted to it, that we have a high opinion of Dr. Borius's work. It is rare that men of his standing reside so long in such a climate, one which during its wet season can only be described as deadly; it is rarer still that while there they display the energy that he did; but it is rarest of all, nay unprecedented, for them to return as he has done to pleasant France, and give to the world a meteorological work of which any one might be proud to be the author.

REVIEWS.

Relation between the Barometric Gradient and the Velocity of the Wind. By W. FERREL, A.M., Assistant United States' Coast Survey.

As this important paper has only been printed in the *American Journal of Science and Arts*, for Nov., 1874, and will have a limited circulation among British readers, we purpose to give here rather a *resumé* of it than a review.

"Let G = the barometric gradient in the direction in which it is the steepest, estimated by the amount of change in the mercurial column in the distance of 100 miles;

v = the velocity of the wind in miles per hour;

r = the radius of curvature of the isobar or line of equal barometric pressure;

i = the inclination of the direction of the wind to the isobar on the side of lowest pressure?

n = the earth's hourly angular velocity of rotation in terms of the radius;

l = the latitude of the place;

P = the barometric pressure of the atmosphere;

P′ = the value of P at the earth's surface.

The following equation then expresses very nearly the relation in all cases between the barometric gradient and the velocity of the wind :—

(1), $G = \frac{(2\,n.\,\sin l + u)\,v.\,\sec i}{8300000} \cdot \frac{P}{P'} = \frac{(\cdot 524 \sin l + u)\,v.\,\sec i}{8300000} \cdot \frac{P}{P'}$ in which

(2), $u = \frac{v.\,\cos i}{r}$."

This law embodies principles which the author states that he has published at different times and places, but he does not give the references to them. On this ground, he excuses a demonstration as too complex and mathematical, and proceeds to give an explanation instead, which he bases upon the law of centrifugal force. He claims for the law as much importance in meteorology, as far as the barometric pressures and the velocities of the winds are concerned, as Kepler's laws were in astronomy, as it must hold good for all latitudes from the equator to the poles, both at sea and on land, and for all altitudes from the earth's surface even beyond the region of the cirrus cloud. He explains that the law accounts for the trade winds and anti-trades, and for the calm belts. "The barometric pressures given by Professor Loomis (Meteorology p. 18) indicate that at about the parallel of 64° N. and about the parallel of 74° S., there is a minimum of barometric pressure, and hence G vanishes in these latitudes, and therefore, for reasons which have already been given, we must have calm belts there." This is the first we ever heard of these calm belts.

We agree that "the real velocities and directions of the mean constant winds have been determined only very roughly from observation on any part of the globe, and hence no very accurate comparisons of our law with observations can be made. Such comparisons, however, all seem to establish the truth of the law within the limits of the errors of observations"; and also, that "the law can only be tested by comparing the average velocity of a great many individual cases with the average of the corresponding gradients, as deduced from the isobars, taking account of the distances of the stations from the centres of curvatures of the isobars." Nevertheless, he proceeds to show how it applies to cyclones; how it accounts for areas of high barometer as well as low, with their calms, and for the force of winds in cyclones at sea exceeding that on land.

He proves by figures indeed too much, for he "shows that the velocity of the wind belonging to the same gradient diminishes considerably towards the centre of the cyclone," overlooking the fact that the gradients always become steeper towards the centre, and are therefore accompanied by stronger winds.

Against several other assertions, not proven might be pleaded, and some might be denied altogether. Thus, where shall we find proof that "in a perfect cyclone the isobars are circular;" that there is a motion "towards the centre below, and from the centre above, in an ordinary cyclone, giving rise to a spiral motion;" that "in order to keep up the motive power of the cyclone, there must be difference of temperature between the internal and external parts." (?) These

statements may be shown to suit the formula, but we cannot accept that as a proof of their being facts.

"The value of i depends upon friction, and its value can only be determined from observation."

"For all ordinary winds it is probable that the value of i is nearly constant for all velocities, and, if so, being once determined from observation for a given kind of surface, as that of the sea, or of any kind of land surface, as that of a prairie, this value is probably applicable to cyclones of all degrees of violence upon such surface except near the centre, and may be regarded as a known and fixed constant for that kind of surface." Here, however, he overlooks that i varies with the latitude, for he elsewhere shows that the greater the latitude the less must be the value of i, and at the equator $i=90°$. We know of no observations which establish it as a fact that $i=90°$ at the equator; indeed, they seem to prove it to be considerably less, nearer 60°.

Mr. Ley obtained for the average of fifteen stations in the British Isles, corresponding to the mean parallel of 55° N., $i=21°$. Professor Loomis, for the United States, mean latitude 40° N., $i=45°$.

The mean constant isobars in the British Islands, as determined by Mr. Glaisher, all effects of the seasons and of local disturbing causes being eliminated, give very nearly $G=\cdot02$ of an inch. With this value, supposing the direction of the wind to be towards the east, or nearly so, so that the value of i is small, we get $v=6$ miles nearly." The law therefore applies very fairly here. "The value of i, except at internal stations where the resistances are great, may be regarded as so small that its secant can be taken as unity, and hence either the gradient or the velocity of the wind is known the one from the other. For inland stations where the resistances are great, the value of i must be obtained from observation."

"Mr Ley likewise obtained the very important result that the difference between the inclination of strong and light winds at stations on the coast is trivial, but at inland stations the mean inclination is less with strong than with light winds, and that at all stations the inclination is more regular with a gale than with light winds. This is all exactly in accordance with the preceding theory, for where the value of u becomes large, as it does near the centre of a cyclone, the value of i must become less."

Referring to the *Quarterly Journal of the Meteorological Society*, 1874, July, we find in the month of December, on the 50th parallel, in the Indian Ocean, $G=\cdot046$, mean direction of the wind N. 60 W., 21 miles per hour. Now, for such a wind, in this latitude, the theoretical value of G is ·075, which we see is greater than the observed.

The difficulty in testing the formula by individual cases, lies in ascertaining, with any approach to correctness, the radius of curvature of the isobar. Let us take Toynbee's synoptic chart for 1870, Feb. 5th, 8 A.M., Greenwich time. Here, in lat. 45° N., long. 25° W., we

take as nearly as possible $r = 350$ miles, $G = \cdot 114$ inch per 100 miles, $i = 45°$, force of wind 9 = 56 miles velocity. For this wind the theoretical gradient is 0·3 nearly, which again is larger than the observed.

Again, Toynbee's chart for January, Sq. 3. in lat, 8° N., long 30° W., gives $G = \cdot 01$, wind N.E. about 20 miles per hour, $i = 45°$. Here the theoretical value of G comes out ·027, which is more than double the actual value.

On the whole, therefore, it may be said that the formula does not completely represent the facts, though probably it may eventually be modified to do so.

By integration of the formula, Mr. Ferrel gets an expression for estimating barometric depressions and he says, "up to this time no meteorologist has accounted for these depressions." Moreover, he claims that this expression accounts for the extremely small barometric oscillations at the equator other than the diurnal range, "where cyclones cannot be formed;" and also for the increase of the mean monthly ranges of the oscillations of the barometer with the latitude.

We have had quite enough to show that Mr. Ferrel's law, if not perfect, is approximative, and takes within its scope a vast range of phenomena. We believe that he is in the right path with his mathematics, and hope that he will keep working upon the subject until he renders his formula more adapted to represent the actualities. For one thing it may be remarked, that the isobars are generally at unequal distances apart, and hence gradients do not apply over a great distance; it would then, apparently, be better to limit the gradient to 60 nautical miles, or one degree of latitude.

R. STRACHAN.

Sur les Observations Pluviométriques faites dans le Sud-ouest de la France surtout de 1861 *à* 1870. Par V. RAULIN. 8vo. 327 pp.

WE have, on several occasions* called attention to the large quantity of good rainfall work done for the South-West of France by Prof. Raulin. We rejoice to learn that it is probable that it will finally assume much larger dimensions than was originally contemplated even by the Professor himself. The introduction to the above set of tables is very short, and gives such a clear account of the present state of the work, and of its prospects, that a translation will be generally interesting:—

"The work previously inserted in the *Actes de l'Académie de Bordeaux*, 1863 and 1864, contains the various series of observations from 1714 to 1860, made in the South-West of France.

"Subsequently, many other series made in the seven Departments have come to my knowledge, and the decade 1861—1870 has been completed, during which also (especially in 1869 and 1870) new stations have been established.

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* *Meteorological Magazine*, vol. I. p. 83; II. p. 71; IV. p. 195; V. pp. 33, 50, 68, 95; VI. p. 86.

"Enlarging the scope of my original work, I have collected the observations made both in the Central Plateau of France, and in the S.E. which joins on to those of Southern Languedoc. Thus I now possess the rainfall observations made throughout the southern half of France, south of a line drawn from Noirmontiers [on the west coast, Lat. 47° N.] through Moulins to Lyons and Geneva. In addition to which I have collected those made in Corsica, in Algeria, and those in the various French colonies in the tropics.

"I have thought that it would be very interesting to publish all these observations uniformly with those previously printed. This opinion having been shared by the Committee of the Learned Societies (Science section), the Minister of Public Instruction has had the kindness to authorise a grant for their publication in the same collection as the previous series.*

"This new work will therefore be divided into seven parts:—

I.—The remainder of the observations made in the S.W. of France.

II.—Observations made in the Central Plateau of France.

III.—Observations made in the S.E. of France.

IV.—Comparisons and deductions from the Observations made in the Southern half of France.

V.—Observations made in Corsica.

VI.—Observations made in Algeria.

VII.—Observations made in French Tropical Colonies.

"The remainder of the observations made in the South-West will be published in exactly the same order as the previous portion, except that the *Appendice intercalaire* of Chapter II.: Aquitaine toulousaine, which includes the Departments of la Corrèze, le Cantal, la Lozère, and l'Aveyron will be transferred to the Central Plateau of which it forms the southern portion.

"I give previously, for each year from 1861 to 1870, comparative tables of the rainfall observations which show, month by month and season by season, the agreements and differences which exist between the amounts collected at the various stations in the same towns or departments, and throughout the South West of France."

Professor Raulin has sketched the outline of a grand work, for which future generations of agriculturists, engineers, and physicists, will indeed be thankful. May he have health, strength, and ample support to enable him to complete it!

Results of an Examination of the United States War Maps for 1872 *and* 1873. By PROF. E. LOOMIS. First and Second Papers. [From *American Journal Science and Art*, 1874.] 8vo., 15 and 14 pages, 3 plates.

IF the Americans do not learn how to make accurate weather-forecasts,

* A little later, when the observations made in Northern France have been collected, I hope it will be possible to publish them also, and thereby to complete the publication of all the rainfall observations made in France and in its various colonies.

or fail to unravel completely the laws which regulate the path of storms, we shall be surprised. They have everything in their favour, the government has placed a large staff and ample funds at the disposal of General Myers, and all his efforts appear to be devoted to these two practical problems. Moreover, both by its extent and by its broad features of physical geography, America is specially adapted as a field for such studies, perhaps unequalled on the globe. And though last, by no means least, there are many men in the States eminently fitted for turning to the best account the copious information published, and liberally circulated, by General Myers.

The two papers above mentioned, though short, are very practical, and afford evidence of the mutual interdependency of several meteorological phenomena, which had previously been "supposed," or "presumed," or assumed to exist, but of which absolute proof had not been forthcoming, while we believe that a few relations are stated for the first time. This is a great gain, and we cordially acknowledge the value of Prof. Loomis's deductions. As it is impossible for us to discuss all the points raised, we think that the best plan will be merely to state the subjects of some of the various sections into which Prof. Loomis has divided his papers. They are as follows:—(1) mean direction, and velocity of translation across America of storm centres in each month of the year; (2) influence of rainfall upon the course of storms; (3) influence of the wind's velocity upon the progress of storms; (4) does the velocity of a storm's progress depend upon the rate at which the barometer falls when the storm is approaching, or upon the rate at which it rises when the storm has passed? (5) to determine whether a storm is increasing, or diminishing in intensity; (6) form of the isobaric curves; (7) where do the storms which seem to come from the far west originate? (8) direction and velocity of wind within areas of maximum pressure; (9) consequences of the outward flow of air from an area of high barometer; (10) monthly minima of temperature; (11) long continued periods of cold weather; (12) connection between the velocity of the wind and the distance between the isobars, in the neighbourhood of a storm centre.

These heads are sufficient to indicate the extreme importance of Prof. Loomis's papers, and the rich harvest which a clear-headed and able man can gather from the United States Weather Maps.

SUPPLEMENTARY TABLE OF MONTHLY RAINFALL, FEBRUARY, 1875.

TRUE to our motto, "Deeds, not words," we sound no flourish of trumpets respecting the following table, and willingly undertake the trouble of its monthly compilation, confident that in the approbation of our readers we shall find our (probably sole) reward. There is, however, one feature to which, if we do not call attention, sufficient weight will not be attached, and we have, therefore, no alternative. Happily, the days when a mere array of names and figures was

assumed to be valuable have passed away. Readers are beginning to realize that it is positively injurious for figures to be numerous, unless they are correct; and that a few judiciously disposed stations are more useful than a large number irregularly distributed. It will be noticed that in order to render the year complete, we have reprinted the values for January.

Station.	County.	Div.	Lat.	Lon.	Total Rain in Jan.	Feb.
					in.	in.
Acol	Kent	II.	51 21 N.	1 19 E.	2·57	0·81
Hailsham	Sussex	,,	50 52	0 16 E.	2·11	1·23
Strathfield Turgiss	Hampshire	,,	51 20	1 0 W.	3·63	2·29
Addington	Bucks.	III.	51 57	0 55	3·28	1·18
Oxford	Oxford	,,	51 45	1 15 W.	3·42	1·63
Cambridge	Cambridge	,,	52 13	0 8 E.	2·24	0·83
Sheering	Essex	IV.	51 48	0 11	2·31	0·71
Ipswich	Suffolk	,,	52 4	1 9	1·83	0·96
Diss	Norfolk	,,	52 22	1 7	2·12	1·22
Swaffham	,,	,,	52 39	0 42 E.	2·40	1·40
Compton Bassett	Wilts	V.	51 27	1 56 W.	5·46	2·12
Hessary Tor, Dartmoor.	Devon	,,	50 33	4 0	19·75	4·85
Teignmouth	,,	,,	50 32	3 30	5·30	1·93
Torrington	,,	,,	50 55	4 11	8·34	1·75
Falmouth	Cornwall	,,	50 9	5 4	6·29	
Taunton	Somerset	,,	51 1	3 6	3·57	2·29
Cheadle	Stafford	VI.	52 58	1 57	3·49	1·39
Ashby de la Zouch	Leicester	VII.	52 45	1 27	5·06	1·08
Coston, Melton Mowbray	,,	,,	52 48	0 45	2·19	1·45
Bucknall	Lincoln	,,	53 13	0 15	1·78	0·94
Mansfield	Nottingham	,,	53 9	1 12	3·38	1·90
Walton, near Liverpool.	Lancaster	VIII.	53 30	2 68	3·88	1·11
Broughton-in-Furness	,,	,,	54 17	3 12	7·95	2·03
Stanley, Wakefield	Yorkshire	IX.	53 43	1 28	3·06	1·22
Gainford	Durham	X.	54 32	1 44	2·36	1·21
Shap	Westmoreland.	,,	54 31	2 41	10·90	1·59
Llanfrechfa	Monmouth	XI.	51 38	2 58	8·32	2·07
Castle Malgwyn	Pembroke	,,	52 3	4 35	7·26	1·68
Heyhope	Radnor	,,	52 23	0 37	5·24	
Melrose	Roxburgh	XII.	55 37	2 48	3·76	1·49
Cessnock, Glasgow	Lanark	XIV.	55 51	4 17	6·70	1·55
Gruinart	Argyll	XV.	55 49	6 20	6·33	1·90
Keith	Banff	XVII.	57 35	2 53	2·09	1·01
Strathconan	West Ross	XVIII.	57 34	4 48	7·19	1·68
Tain, Springfield	East Ross	,,	57 49	4 4	3·70	0·74
Skibbereen	Cork	XX.	51 33	9 16	5·92	2·39
Fermoy	,,	,,	52 3	8 27	9·09	1·86
Kilrush	Clare	,,	52 37	9 29	4·15	0·98
Kilkenny	Kilkenny	XXI.	52 40	7 15	4·33	1·27
Kilsallaghan	Dublin	,,	53 27	6 17	2·69	2·10
Twyford, Athlone	Westmeath	,,	53 26	7 50	5·38	1·46
Ballinasloe	Galway	XXII.	53 19	8 15	5·71	0·90
Kylemore	,,	,,	53 33	9 52	10·80	2·93
Bangor	Mayo	,,	54 8	9 43	5·73	1·89
Carrick-on-Shannon	Leitrim	,,	53 56	8 5	4·55	1·38
Warrenpoint	Down	XXIII.	54 44	6 15	4·83	2·57
Bushmills	Antrim	,,	55 13 N.	6 31 W.	3·15	1·26

ENGLISH AND AUSTRALIAN SEASONS.

To the Editor of the Meteorological Magazine.

SIR,—The query contained in the accompanying letter, I am unable to answer. Can you afford me any solution of the matter, or would you kindly publish the letter in extenso in your columns to provoke enquiry and ventilate the question.

Very faithfully, yours,

C. H. GRIFFITH, F.M.S.

Strathfield Turgiss, March 3rd. 1875.

The Vicarage, Mortimer West End, Reading, Feb. 23, 1875.

DEAR SIR,—As you are much interested in Climatology I write to bring under your notice a matter which you might like to know of, unless (as is very probable) you are already acquainted with it.

When Archdeacon Harper was in England, eight or nine years ago, he told me that he had compared the seasons for the four previous years, and had found that the general character of *our* season followed that which had preceded it at the Antipodes. He had not thought of making any comparison before the date mentioned. So limited a range of observation could of course *prove* nothing. Since I met Harper, I have remarked that the statements in the newspapers about the Australian seasons have been similar to what has followed here. Last summer I read in the *Times* that they were finishing the severest winter known in those colonies, and we certainly have got a long and severe season now.

If this supposed similarity of the seasons is new to you, I think you might find it worth while to compare the records of Australian seasons with ours to see whether (as a general rule) we follow their lead. If it should prove to be the case, it would be a most useful point to establish.—Believe me, yours very truly,

REV. C. H. GRIFFITH. A. L. WHITE.

P.S..—I have only *occasionally* had an opportunity of comparing our seasons with those at the Antipodes.

[This very important question can only be answered after considerable research. Absolutely unassailable (and hitherto unattainable) facilities for its investigation are now regularly published in our cotemporary "The Colonies," whose last table, August, 1874, gave returns from

England	Ceylon	Falkland Isles
Cape of Good Hope	Queensland	Barbados
Mauritius	N. South Wales	Honduras
Calcutta	Victoria	Canada
Bombay	Tasmania	Newfoundland
Madras	New Zealand	British Columbia

We recommend careful examination of these tables, and with reference to previous years are quite ready to help (by the loan of copies of Australasian returns) any one who will tackle the question, but we really cannot promise to undertake it ourselves.—ED.]

FEBRUARY, 1875.

Div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Date.	Days on which ·01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32° In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	1·06	— ·16	·36	11	16	51·2	14	25·1	24	19	24
II.		Maidstone (Linton Park)	·93	— ·58	·19	25	10	55·0	15	21·0	6, 24	23	...
,,		Selborne (The Wakes)	2·20	+ ·49	·56	6	11	49·5	14	21·0	9	19	24
III.		Hitchen	1·05	— ·21	·27	11	10	45·0	1, 15	20·0	23	26	...
,,		Banbury	·96	— ·47	·15	20*	15	53·0	14	23·0	6	25	..
IV.		Bury St. Edmunds (Culford)	1·21	— ·21	·40	11	12	51·0	14	17·0	23	23	25
V.		Bridport	2·30	+ ·24	·80	6	9	55·0	13	25·0	5, 11	22	...
,,		Barnstaple	1·79	— ·29	·70	6	8	53·0	14†	30·0	6‖	..	...
,,		Bodmin	1·65	— 1·14	·62	11	11	53·0	14	27·0	23	8	11
VI.		Cirencester	2·56	+ ·95	·68	6	10	...	...	...	...	...	...
,,		Shifnal (Haughton Hall)	1·56	+ ·67	·57	20	·12	50·0	1‡	23·0	5, 6	19	23
,,		Tenbury (Orleton)	2·14	+ ·57	·37	25	13	54·5	14	24·3	6	19	21
VII.		Leicester (Belmont Villas)	1·09	...	·31	11	14	55·0	14	26·0	22	18	...
,,		Boston	1·69	+ ·48	·40	20	12	53·0	14	27·0	6, 7	19	...
,,		Grimsby (Killingholme)	1·01	...	·30	24	13	52·0	14	25·0	6	11	...
,,		Derby	...	...	...	...	...	...	...	...	...	...	..
VIII.		Manchester	·74	— 1·21	·16	11	10	52·0	14	23·0	5	13	21
IX.		York	1·20	— ·18	·26	11	11	50·0	14	22·0	6	17	...
,,		Skipton (Arncliffe)	1·92	— 1·75	·57	11	14	46·0	13	20·0	3	11	...
X.		North Shields	1·21	— ·32	·16	24	19	52·0	1	27·4	6	13	17
,,		Borrowdale (Seathwaite)	...	...	...	...	...	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)	...	...	...	...	...	...	...	...	...	...	...
,,		Haverfordwest	2·80	— ·06	1·14	6	10	52·5	12	24·0	23	15	21
,,		Rhayader (Cefnfaes)	...	...	...	...	...	...	...	...	...	...	...
,,		Llandudno	2·14	+ ·79	·44	20	16	55·5	13	29·5	10	9	...
XII.	SCOTLAND.	Dumfries (Crichton Asylum)	1·18	— 1·37	·26	13	10	50·7	15	21·0	5	22	25
,,		Hawick (Silverbut Hall)	1·07	...	·23	13	15	...	...	...	...	...	..
XIV.		Kilmarnock (Annanhill)	1·32	...	·49	13	9	52·3	14	24·0	4	13	17
XV.		Castle Toward	1·50	— 2·24	·45	12	7	52·0	14§	...	...	17	...
XVI.		Leven (Nookton)	1·86	+ ·16	·45	24	14	54·0	16	20·0	5	20	26
,,		Stirling (Deanston)	...	...	...	...	...	...	...	...	...	...	...
,,		Grandtully	...	...	...	...	...	...	...	...	...	...	...
XVII.		Braemar	·81	— 1·17	·20	13	14	48·9	1	11·0	5	20	25
,,		Aberdeen	1·74	...	·48	7	15	52·1	14	18·8	6	8	22
XVIII		Loch Broom	...	...	...	...	...	...	...	...	...	.	...
,,		Portree	3·20	— 7·03	1·05	13	13	...	...	...	...	...	...
,,		Inverness (Culloden)	·71	— 1·17	...	...	14	50·1	13	22·0	6	16	25
XIX.		Helmsdale	1·97	...	·46	7	19	...	...	...	...	...	...
,,		Sandwick	1·99	— ·49	·42	11	20	48·0	1	28·0	24	7	14
XX.	IRELAND.	Caherciveen Darrynane Abbey	2·48	...	·50	11	13	...	...	...	...	...	...
,,		Cork	1·41	...	·33	3	17	...	...	...	...	...	...
,,		Waterford	...	...	...	...	...	...	...	...	...	..	...
,,		Killaloe	1·75	— 1·15	·40	11	16	...	...	26·0	23	...	...
XXI.		Portarlington	1·78	— ·25	·38	21	21	53·0	13	27·5	3	14	...
,,		Monkstown, Dublin	2·52	+ ·88	·67	20	16	...	..	...	...	..	...
XXII		Galway	1·04	...	·33	12	10	53·0	1, 2†	27·0	23	7	...
,,		Ballyshannon	1·41	...	·60	13	14	...	...	...	..	...	...
XXIII		Waringstown	...	...	...	..	...	...	..	...	..	...	...
,,		Edenfel (Omagh)	1·23	...	·47	13	12	50·0	13	21·0	3	22	...

* And 24. † 15. ‡ 13 & 14. § 15 & 16. ‖ 24 & 25.

+Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON FEBRUARY.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail: S for Snow.

ENGLAND.

CAMDEN TOWN.—Only one day on which the temp. in shade reached 51°, and only four on which it did not go down to 32°.

LINTON.—A very dull, cold month, but not a wet one, the downfall being mostly in snow, the latter part of the month very wintry. Winds (never very high) mostly N. and E. Bar. very low on 24th, without much change. The month contrasts strongly with January, yet on the whole has been favourable to farming operations, if milder weather follows. Highest bar. (at noon) 30·18 on the 1st, the lowest 28·94 on 24th.

SELBORNE.—Mean max. ther. 39°·5; mean min. 30°·2; the coldest February excepting 1873 for 10 years. Considerable suffering from rheumatism; death-rate very high. It is remarkable that so mild a January should intervene between two such exceptionally cold months as December and February.

BANBURY.—High wind on 16th.

CULFORD.—An exceedingly cold month, the mean temp. being only 34°·6. Only five nights on which the mercury did not fall to or below the freezing point, the lowest being 17° on the 23rd, and the max. temp. of the last two days was only 32°. S fell more or less on six days, with heavy fog on 14th and 15th; cold easterly winds on 15 days.

BRIDPORT.—A cold month, and a great part of it very gloomy, with a prevalence of N. and N.E. wind.

BODMIN.—Rainfall (1·65) is 1·71 below the average of 26 years.

SHIFNAL.—Bees out, and throstles singing on the 15th. A most unusually severe February, and strange contrast to the previous mild month. The first three days were pleasant, the ther. standing at 50° on the 1st, but on the night of the 3rd frost set in, which continued, with two exceptions (12th and 13th), till the close. The average max. temp. was 40°, average min. 31°. Although the gauge records 1·56, ·97 of it was snow, a fall of 5 inches taking place on the night of the 20th, followed by frequent showers of sleet till end of month. Thick fog on 7th; S.E. winds prevailed from 7th to 11th, and N.E., from 18th to the close; the rest were N.W. or W.

ORLETON.—A very cold and cloudy month; at the beginning and in the middle there were a few warm days, the remainder very frosty, with low mid-day temp. The sun was rarely seen and the ground generally covered with S, which quickly melted or was dried up by the cold N.E. wind that prevailed. The mean temp. of the month was more than 5° below the average.

LEICESTER.—Very winterly weather, with the exception of a few days in the middle. Easterly winds more frequent than is usual in February. Bar. generally very high till the 19th.

BOSTON.—Temp. 3°·3 below average of the last 11 years; rainfall 1·33 above the average of the previous 20 years. N.E. winds much in excess of the average for February. On the 20th the snow remained on the ground to the depth of from 4 to 5 inches.

GRIMSBY.—A month of unusually cold unpleasant weather; E. winds during the latter half of the month, and in the last ten days the temp. never reached 40°, the highest point reached on 27th and 28th was only 33°.

NORTH SHIELDS.—Plants in flower at the beginning of the month—Christmas rose, auricula, white rock cress; on 8th, yellow aconite; in the middle of the month, snowdrop, snowflake, and yellow jessamine, and crocus on the 21st.

WALES.

HAVERFORDWEST.—This month was a striking contrast to the previous one, being cold, dry, generally overcast, and frosty, with cold E. winds. The mean temp. of the last 11 days was 33°·7. As usual this month had not much R, the

wind blowing from the E. from the 24th to 27th. S on the Precelly range from the 20th to the end of the month.

LLANDUDNO.—Only eight fine days, the remainder dull and cold, particularly the last ten days. Gorse in flower on 12th, hyacinth in full flower in the open garden on 13th; elder, honeysuckle, eglantine, and gooseberries in bud. S on the hills from the 21st to the end.

SCOTLAND.

DUMFRIES.—Month dry and cold; rainfall far below the average. Prevailing winds E. and N.E.

HAWICK.—First half of the month fresh and favourable for getting forward all kinds of out-door work; but the cold E. winds, the frost, S, and H of the latter half put an effectual stop to nearly all our out-door operations.

ANNANHILL.—Bar. pressure higher than last month from 1st to 11th, and from 15th to 22nd there were two periods of high pressure accompanied by cold E. winds and a low temp.; the prevailing winds were N.E., E., and S.E., usually light to moderate; strong N.E. gale on 24th, pressure 16 lbs. to the square foot. The month was cold and bleak, with blighting winds, ungenial and treacherous, there being only 6 days on which there was no E. in the wind. Rainfall, light.

CASTLE TOWARD.—Rainfall much below the average, and only on 7 days; the amount of sunshine small, and in the early part of the month great fog on the land and much greater on the water, river steamers being delayed, the river traffic both ways at a stand-still. On 23rd slight fall of S, followed by a heavy gale from N.N.E., and on 25th a slight fall of S, the tree-tops white; from the 25th cold E. winds set in, and the weather being bitterly cold, with winds drying the ground, farm operations were carried on speedily.

BRAEMAR.—The former part of the month fine, the latter part very severe.

ABERDEEN.—A month of dull, cold and rather dry weather, with piercing E. winds. S never deep except where it was blown. Mean bar. (corrected) 0·25 in. higher than the mean of 18 years; wind pressure considerably below the average, but the wind from E. and N.E. much above it; mean temp. 36°·7 or 1°·1 below the (18 years) average, and the R rather more than half-an-inch below it.

PORTREE.—A month of very severe frosts, most of the evergreen shrubs completely destroyed; gale on the 23rd from N.E. with drifting S. The severest February since 1866; sheep and cattle half starved, the pastures being all frozen up, and provender for hand-feeding very scarce. The rainfall 5·93 in. below the average of the last 15 years, 1860-74.

CULLODEN.—L seen on the morning of the 1st; intense frost on 6th; faint aurora in the N. on 11th; chaffinch began to sing on the 11th, and the thrush on 13th; violets and primula in bloom on the 12th. On 23rd constant S from 6 a.m. to 2 p.m., 3½ in. on the ground; sharp frost; half-an-inch of fresh S in the night of 23rd. On 24th slight showers of H and S drifting in the day; sharp frost and another half-inch of S during the night.

IRELAND.

DARRYNANE.—First half of the month very mild, but wet and foggy; winds variable and moderate. Second half dry and cold, with fresh N.E. winds during the last week. S on 24th, and frost daily from 15th to 24th, inclusive.

MONKSTOWN.—Weather nothing remarkable till the 20th; from then to the end of the month heavy R, alternating with S; heavy S on night of 23rd.

BALLYSHANNON.—The month has been an unusually dry one, but marked throughout by sharp winds (mostly easterly), and continued lowness of temp. There is but little sign of Spring yet. Frost at night, and light falls of S.

EDENFEL, OMAGH.—The weather of the month has been for the most part dry and cold, the last 10 days especially having been exceedingly bitter and inclement. On 22 days the wind blew from some point of N. or E.

Returns too late for insertion in table:—

Lochbroom.....	2·30	...	·28	16	17	...	...	...	...	...	...	...
Waringstown.....	1·46	...	·33	13 & 26	11	54·0	8	23·0	4	18	26